Important Viscosity and Density of Lubricant Formulas PDF

Formulas
Examples
with Units

List of 12
Important Viscosity and Density of Lubricant Formulas

1) Absolute Viscosity of Oil in Terms of Tangential Force Formula

Evaluate Formula

Formula

$$\mu_o = P \cdot \frac{h}{A_{po} \cdot V_m}$$

Example with Units

$$489.1429\,\text{cP} = 214\,\text{N} \cdot \frac{0.02\,\text{mm}}{1750\,\text{mm}^2 \cdot 5\,\text{m/s}}$$

2) Area of moving plate of sliding contact bearing given absolute viscosity Formula

Evaluate Formula

Formula

$$A_{po} = P \cdot \frac{h}{\mu_o \cdot V_m}$$

Example with Units

$$1746.9388\,\text{mm}^2 = 214\,\text{N} \cdot \frac{0.02\,\text{mm}}{490\,\text{cP} \cdot 5\,\text{m/s}}$$

3) Density in Terms of Kinematic Viscosity and Viscosity for Sliding Contact Bearing Formula

Evaluate Formula

Formula

$$\rho = \frac{\mu_l}{z}$$

Example with Units

$$0.88\,\text{g/cm}^3 = \frac{220\,\text{cP}}{250\,\text{cSt}}$$

4) Density of Lubricating Oil in Terms of Temperature Rise Variable Formula

Evaluate Formula

Formula

$$\rho = TRV \cdot \frac{p}{C_p \cdot \Delta t_r}$$

Example with Units

$$0.8678\,\text{g/cm}^3 = 21 \cdot \frac{0.96\,\text{MPa}}{1.76\,\text{kJ/kg*°C} \cdot 13.2\,°\text{C}}$$

5) Kinematic Viscosity given Viscosity and Density for Sliding Contact Ball Bearing Formula

Evaluate Formula

Formula

$$z = \frac{\mu_l}{\rho}$$

Example with Units

$$250\,\text{cSt} = \frac{220\,\text{cP}}{0.88\,\text{g/cm}^3}$$

6) Kinematic Viscosity in Centi-Stokes in Terms of Viscosity in Saybolt's Unversal Seconds Formula

Evaluate Formula

Formula

$$z_k = (0.22 \cdot t) - \left(\frac{180}{t}\right)$$

Example

$$34.075 = (0.22 \cdot 160) - \left(\frac{180}{160}\right)$$

7) Velocity of Moving Plate in Terms of Absolute Viscosity Formula

Evaluate Formula

Formula

$$V_m = P \cdot \frac{h}{\mu_o \cdot A_{po}}$$

Example with Units

$$4.9913\,\text{m/s} = 214\,\text{N} \cdot \frac{0.02\,\text{mm}}{490\,\text{cP} \cdot 1750\,\text{mm}^2}$$

8) Viscosity in Terms of Absolute Temperature for Sliding Contact Bearing Formula

Evaluate Formula

Formula

$$\mu_o = 10^{\left(A + \left(\frac{B}{T_{abs}}\right)\right)}$$

Example with Units

$$485.695\,\text{cP} = 10^{\left(-6.95 + \left(\frac{3180}{330}\right)\right)}$$

9) Viscosity in Terms of Flow Coefficient and Flow of Lubricant Formula

Evaluate Formula

Formula

$$\mu_l = q_f \cdot W \cdot \frac{h^3}{A_p \cdot Q_{bp}}$$

Example with Units

$$219.9185\,\text{cP} = 11.80 \cdot 1800\,\text{N} \cdot \frac{0.02\,\text{mm}^3}{450\,\text{mm}^2 \cdot 1717\,\text{mm}^3/\text{s}}$$

10) Viscosity in Terms of Kinematic Viscosity and Density for Sliding Contact Bearing Formula

Evaluate Formula

Formula

$$\mu_l = z \cdot \rho$$

Example with Units

$$220\,\text{cP} = 250\,\text{cSt} \cdot 0.88\,\text{g/cm}^3$$

11) Viscosity of Lubricant in Terms of Flow of Lubricant Formula

Evaluate Formula

Formula

$$\mu_l = \Delta P \cdot b \cdot \frac{h^3}{12 \cdot l \cdot Q_{slot}}$$

Example with Units

$$231.3889\,\text{cP} = 5.1\,\text{MPa} \cdot 49\,\text{mm} \cdot \frac{0.02\,\text{mm}^3}{12 \cdot 48\,\text{mm} \cdot 15\,\text{mm}^3/\text{s}}$$

12) Viscosity of Lubricant in Terms of Sommerfeld Number of Bearing Formula

Evaluate Formula

Formula

$$\mu_l = 2 \cdot \pi \cdot S \cdot \frac{p}{\left(\frac{r}{c}\right)^2 \cdot n_s}$$

Example with Units

$$219.3982\,\text{cP} = 2 \cdot 3.1416 \cdot 2.58 \cdot \frac{0.96\,\text{MPa}}{\left(\frac{25.5\,\text{mm}}{0.024\,\text{mm}}\right)^2 \cdot 10\,\text{rev/s}}$$

Variables used in list of Viscosity and Density of Lubricant Formulas above

- **A** Constant a for Viscosity Relationship
- A_p Total Projected Area of Bearing Pad *(Square Millimeter)*
- A_{po} Area of Moving Plate on Oil *(Square Millimeter)*
- **b** Breadth of Slot for Oil Flow *(Millimeter)*
- **B** Constant b for Viscosity Relationship
- **c** Radial Clearance for Bearing *(Millimeter)*
- C_p Specific heat of bearing oil *(Kilojoule per Kilogram per Celcius)*
- **h** Oil Film Thickness *(Millimeter)*
- **l** Length of Slot in Direction of Flow *(Millimeter)*
- n_s Journal Speed *(Revolution per Second)*
- **p** Unit bearing pressure for bearing *(Megapascal)*
- **P** Tangential force on moving plate *(Newton)*
- Q_{bp} Flow of Lubricant Across Bearing Pad *(Cubic Millimeter per Second)*
- q_f Flow Coefficient
- Q_{slot} Flow of Lubricant From Slot *(Cubic Millimeter per Second)*
- **r** Radius of Journal *(Millimeter)*
- **S** Sommerfeld Number of Journal Bearing
- **t** Viscosity in Saybolt Universal Seconds
- T_{abs} Absolute Temperature of Oil in Kelvin
- **TRV** Temperature Rise Variable
- V_m Velocity of Moving Plate on Oil *(Meter per Second)*
- **W** Load Acting on Sliding Bearing *(Newton)*
- **z** Kinematic Viscosity of Lubricant Oil *(Centistokes)*
- z_k Kinematic Viscosity in Centi-Stokes
- **ΔP** Pressure Difference Between Slot Sides *(Megapascal)*
- Δt_r Temperature Rise of Bearing Lubricant *(Degree Celsius)*

Constants, Functions, Measurements used in list of Viscosity and Density of Lubricant Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Area** in Square Millimeter (mm^2)
  Area Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Millimeter per Second (mm^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Temperature Difference** in Degree Celsius (°C)
  Temperature Difference Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilojoule per Kilogram per Celcius (kJ/kg*°C)
  Specific Heat Capacity Unit Conversion
- Measurement: **Dynamic Viscosity** in Centipoise (cP)
  Dynamic Viscosity Unit Conversion
- Measurement: **Kinematic Viscosity** in Centistokes (cSt)
  Kinematic Viscosity Unit Conversion
- Measurement: **Angular Velocity** in Revolution per Second (rev/s)
  Angular Velocity Unit Conversion
- Measurement: **Density** in Gram per Cubic Centimeter (g/cm^3)
  Density Unit Conversion

- μ_l Dynamic Viscosity of Lubricant *(Centipoise)*
- μ_o Dynamic Viscosity of Oil *(Centipoise)*
- ρ Density of Lubricating Oil *(Gram per Cubic Centimeter)*

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